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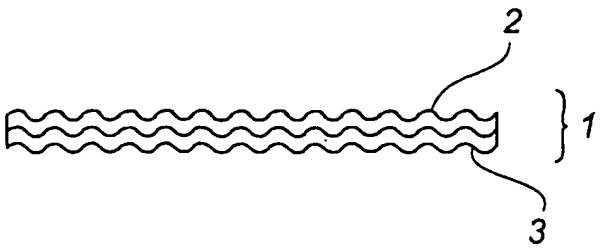
(54) Title: NONWOVEN FOR SOUND-INSULATING APPLICATIONS



(57) Abstract: The invention relates to a fibrous material for sound insulation in, for example, vehicles. The fibrous material comprises a first layer (2) of a continuous fibrous material, which has a portion of at least 50 % of short fibres having a length below 10 mm, a second layer (3) for free fibres or a fibrous web with a portion of at least 50 % of long libres having a length above 20 mm, and a binder in the form of a polymer which is added as latex and bonding the fibres in the two layers and which has thermoplastic properties after manufacturing the fibrous material. The invention further relates to a method for manufacturing the fibrous material, and using the fibrous material in a sound-insulating material.

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NONWOVEN FOR SOUND-INSULATING APPLICATIONS

Field of the Invention

The present invention relates to a fibrous material for sound insulation in, for instance, vehicles. The invention further relates to a method for manufacturing a fibrous material for sound insulation in, for example, vehicles.

Technical Background

Sound insulation is required in many different applications, such as in dwellings, in offices, in industrial premises and in vehicles.

Since a person's sense of hearing is temporarily blunted or permanently impaired even at relatively low sound levels if staying in noisy environments for a long period of time, it is important to the fullest possible extent to avoid undesirable sound. Another important aspect is that we humans to a high degree use our sense of hearing to avoid danger. For example, it is important for car drivers to be able to hear approaching emergency vehicles, as well as it is important for industrial workers to hear warning signals or warning cries from fellow workers. A conventional sound-insulating material often consists of a relatively thick, airy material similar to the materials which are used in the walls of a house as thermal insulation.

In order to avoid that a motorcar engine gives off disturbing sound levels, the engine is suspended from the chassis with vibration dampening sleeves and the engine compartment is sound-insulated. Conventional insulation of engine compartments, such as bonnet insulation, usually consists of cotton rags which have been put together with a layer of non-woven and which have been condensed under pressure and at an elevated temperature. The pur-

pose of the layer of non-woven is to have a joining effect and, to be water and oil repellent and to serve as a flame retardant. By this design, the thicker the cotton rags, the better the sound insulation. However, this means that the insulation becomes too heavy and unnecessarily bulky.

Non-woven is a material that mainly consists of separate textile fibres which are held together by so-called bonding. Bonding is a method of textile technology for holding together fibres or threads mechanically or physicochemically (by gluing or melting). Non-woven is usually classified as fabric or flexible sheet material and is used in a wide variety of technical fields. For example, non-woven can be used as surgical drapes, outer layers of insulation, or other applications where a thin and light layer of material is desirable but where also considerable tensile strength or tear strength is required. It is also possible to manufacture non-woven type materials with considerably greater thickness and, thus, to use these directly as insulation material.

WO93/18218 discloses a number of different variants of insulation material of the above-mentioned type. More specifically, an insulation material which is intended for passenger compartments of vehicles and which consists of a sound-absorbing intermediate layer and two outer layers is disclosed, of which the outer layer turned towards the passenger compartment is sound permeable and the outer layer which is turned away from the passenger compartment is sound-reflecting. By this design, the insulation material is considered, on the one hand, to receive and absorb sound from the passenger compartment and, on the other, to shut out noise and the like from the road. However, the aim of the WO specification is how to obtain material with sound-permeability and sound-absorption properties, and the sound-reflecting material is not disclosed in more detail.

In addition to said WO specification, there are a countless number of documents which, on the one hand, disclose different types of fibrous material that correspond to the cotton rags and, on the other, disclose different methods for manufacturing the material at issue.

For example, US-A-2 695 855 discloses a fibrous material which has been impregnated with rubber latex and a curing polymer in such a manner that the material in connection with drying and curing should form an open network-like/honeycomb-like pattern with gaps in between. This material is a variant of the above-mentioned cotton rags and exhibits, just as the cotton rags, sound-absorption properties due to its airy structure.

Further examples of how to use non-woven material with the purpose of sound insulation, are found, inter alia, in GB-1 391 878 which relates to the use of a special copolymer latex for bonding the fibres to one another in the non-woven.

It has lately been found that the sound-insulating ability of a material also depends on the air permeability of the material. One way of improving the sound-insulating ability is to coat the thick, airy material with a layer of a material that has considerably lower air permeability. Great demands are made on this layer. For example, it has to be strong, flexible, light, and easy to form, it must be possible to treat it with a flame retardant, it has to be possible to treat it in such a manner that it is made oil repellent and, moreover, it must have low air permeability. The materials described above do not correspond to all these material requirements. The non-woven material in conventional bonnet insulation has air permeability in the range of 3000-5000 litres/(m^2*s), which is considered to be too high, and the cotton rags are, as mentioned above, too heavy.

Summary of the Invention

An object of the invention is to provide a material which has low air permeability and low weight per unit area.

Another object of the invention is to provide a material which corresponds to the above-mentioned demands with respect to strength, flexibility, and ductility.

The present object has been achieved by means of a fibrous material which is characterised in that it comprises a first layer of a continuous fibrous material which has a portion of at least 50 % of short fibres having a length below 10 mm, a second layer of free fibres or a fibrous web with a portion of at least 50 % of long fibres having a length above 20 mm, and a binder in the form of a polymer which is added as latex and bonding the fibres in the two layers and which has thermoplastic properties after manufacturing the fibrous material.

This material is light. It exhibits a high degree of strength. It is flexible and can easily be formed. Furthermore, it can be treated with a flame retardant and be made oil repellent. In addition, the material has low air permeability in relation to its weight per unit area. As will be disclosed in the description of preferred embodiments, for instance, air permeability can be achieved which is as low as about 100 $l/(m^2*s)$ at a weight per unit area of only about 63 g/m^2. Suitable layers of material which exhibit the convenient portions of fibre of a predetermined length are, for example, non-woven or fibrous web (the layer of long fibres) and tissue material (the layer of short fibres). Conventional non-woven material and tissue material have air permeability in the range of 3000-5000 $l/(m^2*s)$ and in the range of 2000 $l/(m^2*s)$, respectively. By bringing these two layers together and impregnating them, a fibrous material with low air permeability and with maintained low weight per unit area can thus be obtained. The weight relative to the desired parameter (in this case, inter alia, low air

permeability) is often of great importance. For example, within the motor industry attempts are made to reduce the weight of insulation material as much as possible. Advantageously, the above-described material can be used as bonnet insulation. It corresponds to all the above-mentioned demands which are made on a material in bonnet insulation.

Above all, the fibrous material obtains its advantageous material properties by the combination of layers having short and long fibres, respectively, and the impregnation with thermoplastic latex. The short fibres together with the polymer added as latex form a relatively dense material with low air permeability. Above all, the fibrous material obtains its strength and flexibility due to the layer with the long fibres. Owing to the fact that the fibres are relatively free (above all, in the layer with long fibres) when being brought together and impregnated, an excellent bond between the layers is obtained. The free fibres engage with one another in connection with the impregnation and the subsequent drying. When putting together layers which each separately are dense, finished material webs, it can otherwise be difficult to obtain a satisfactory bond between the layers.

Preferred embodiments will be evident from the sub-claims.

Advantageously, the fibrous material has a thickness below 2 mm. Such a thin material is light and flexible and can be easily formed. Since it can be treated with a flame retardant and be made oil repellent, it is a material which may be used in many different ways, for example, as part of a sandwich construction.

According to a preferred embodiment, the polymer added as latex constitutes at least about 15 %, and preferably at least about 20 % by dry weight of the fibrous material. The quantity of added polymer considerably affects the density of the fibrous material. The choice of the quantity of polymer, in its turn, depends on the

character of the first layer. A first layer which has a relatively high portion of short fibres and which is relatively dense from the start requires a smaller quantity of polymer compared with a first layer which is relatively airy or non-dense. On the other hand, a first layer with very short fibres may require a certain quantity of polymer in order to make the fibres in the material "stick together" so that the material obtains the requisite strength.

Advantageously, the coherent fibrous material is creped. This means that the layer of material with the short fibres can be stretched to a relatively large degree without being torn to pieces. This flexibility gives the layer of short fibres such an extension ability that the resultant fibrous material can be stretched to the same degree as a conventional non-woven material, i.e. notably more than a smooth (non-creped) material of short fibres can.

As mentioned previously, a high portion of short fibres in the first layer results in a material with low air permeability, while a high portion of long fibres in the second layer results in a material with the necessary strength. The portion and the current length of the fibres in the different layers can vary with respect to the material requirements as regards different fields of application.

The previously mentioned object is also achieved by a method for manufacturing a fibrous material in accordance with the independent claim of method.

Besides, the object of the invention is achieved by using the previously described fibrous material in a sound-insulating material in accordance with the independent claims as regards the use of the fibrous material in a sound-insulating material and the sound-insulating material as such.

According to a preferred embodiment, the sound-insulating material comprises a second layer of a fibrous

material with a thickness above about 5 mm. This second layer can, for example, be cotton rags or the like, the resultant sound-insulating material being, for instance, used as bonnet insulation.

According to another preferred embodiment, the sound-insulating material comprises a second layer of a fibrous material with a thickness below about 5 mm. This results in a thin material which, for example, can be used as insulation on the floor of a car or the like. This insulation can, for instance, be included in the floor carpet and the ceiling, respectively.

Brief Description of the Drawings

The invention will be described in more detail in the following with reference to the accompanying schematic drawings which by way of example show the embodiments of the invention preferred at present, in which

Fig. 1 shows an enlarged cross-section of a fibrous material according to a preferred embodiment of the invention,

Fig. 2 shows the fibrous material according to the invention in a sandwich construction together with one or more additional layers, and

Fig. 3 schematically shows equipment for manufacturing a fibrous material.

Description of a Preferred Embodiment

The fibrous material 1 comprises a first layer 2 of a so-called tissue material which has been brought together with a second layer 3 of a non-woven material (see Fig. 1). In order to hold the material 1 together, it has been impregnated with latex.

The manufacture takes place according to the following:

A. Manufacturing tissue material.

B. Manufacturing fibrous web.

C. Bringing the tissue material and the fibrous web together.
D. Impregnating the combined materials with latex.
E. Removing excess latex.
F. Drying the fibrous material.
G. Winding the fibrous material.
H. Using the fibrous material.

Fig. 3 shows the principle of manufacturing the fibrous material. The tissue layer 2 is conducted on an endless wire or the like. From above, the fibrous web 3 is supplied from an endless wire or the like. The joined layers 2, 3 are conducted to a station of impregnating D and further to a station E, in which excess latex is removed. Subsequently, the fibrous material is dried in a drier F and wound on a roll G.

A. Manufacturing the Tissue Material

The first layer 2 has a large portion of short cellulose fibres with a length in the range of 1.5-3 mm. The fibres can be brought together by so-called wet laying or by so-called dry laying. The most common thing is to use wet laying when such short fibres are to be handled. Wet laying means that a thin layer of fibres and any binders are spread out by means of nozzles or the like when the fibres are suspended in a liquid. After having been spread out, the layers are dried in such a manner that the desired fibrous material is formed.

The short fibres constitute almost 100 % of the fibres in the tissue material.

In connection with the drying, the tissue material is creped to a degree of creping in the range of 20-30 %. The degree of creping is usually defined as the difference in length of the creped material in a creped and a stretched, smooth position, respectively, relative to the stretched length.

B. Manufacturing the Fibrous Web

The fibrous web is manufactured by the desired fibres being mixed and carded to a fibrous web. The fibres in the second layer 3 is a mixture of polyester and viscose fibres. These synthetic fibres have a relatively well-defined length which in this case is in the range of 40 mm. The fibrous web can be needled together by hydroentanglement or the like.

The long fibres constitute almost 100 % of the fibres in the fibrous web.

C. Bringing the Tissue Material and the Fibrous Web together

After the two more or less continuous materials have been manufactured, they are continuously brought together in the form of two material webs which run along one another. The fibrous web is conducted above the relatively stronger tissue material since the stronger material can support the weaker fibrous web at open parting locations, if any, in the feeding of the material web.

D. Impregnating the Combined Materials with Latex

After the two materials have been combined, they are impregnated with latex. The impregnation can take place by means of foam impregnation, dip impregnation or the like.

The polymer added as the latex is intended to bond the fibres to one another in the two layers 2, 3. The fibres have to be bonded mutually to one another in the layers, as well as to fibres from the second layer. By bringing two layers of material together in which the fibres are not particularly firmly bonded to one another before the joining, fibres in each of the layers may bond to fibres in the other layer. This means that very strong bonding between the two layers is obtained, whereby it is largely avoided that the two layers let go of one another when forming the end product.

The polymer which is added as latex is a thermoplastic. In the present case an EVA latex, acrylate latex or modified acrylate latex is used. This results in the fibrous material still having thermoplastic properties after having been dried. These polymers will not cure until at temperatures of about 180°C, which is considerably higher than the temperatures that the material usually achieves in connection with drying. In addition, this curing temperature is decidedly higher than the temperatures to which the motor industry exposes the material, for instance, in connection with repainting or the like. The material will thus remain at least partly thermoplastic, which facilitates the forming of the material and which involves that breaking of the material when forming an end product to a high degree is avoided.

In connection with the impregnation with latex of the fibrous layers, it is also possible to add substances for dyeing, treatment with a flame retardant and with oil repellency.

The polymer added as latex constitutes about 22-23 % by weight of the total oven-dry mass of the fibrous material.

E. Removing Excess Latex

After the impregnation, which advantageously is carried out in such a manner that the latex is added in excess, the excess is removed by means of suction boxes, a roll nip or the like.

By impregnating with latex in excess and then removing the excess, a fibrous material is obtained which is properly wetted and which with satisfactory accuracy contains the desired quantity of latex.

F. Drying the Fibrous Material

Subsequently, drying of the combined and impregnated fibrous material was carried out. The highest drying temperature which the fibrous material achieves in the final

stage of the drying is lower than the curing temperature of the polymer added as latex. However, the drying temperature should be so high that the polymer added as latex, at least partly, melts and bonds the fibres to one another in the different layers.

When selecting drying process, attention should be paid to how the drying air currents are conducted relative to the fibrous material web. Air currents which are passed through the fibrous material will affect the final air permeability of the fibrous material negatively (i.e. the air permeability will be higher and, in all probability, far too high). Advantageously, a so-called convection dryer is used, in which the drying air currents are conducted parallel to, instead of right through, the the fibrous material web. It becomes more and more important to take this factor into consideration, the drier the fibrous material has had time to become in the dryer. This factor should also be taken into consideration when removing the excess latex.

G. Winding the Fibrous Material

After drying, the fibrous material is usually wound on a roll.

H. Using the Fibrous Material

The fibrous material manufactured in the way described above complies with the requirements which have been mentioned previously: low air permeability relative to the weight per unit area, strong, flexible, light, easy to form. The fibrous material can, for instance, be used as a layer in bonnet insulation, the floor carpet of a car, insulating material within the aircraft industry or the like. The fibrous material can, of course, be used at a large number of other locations, such as industry wall insulation, machine hoods or the like. However, it is within the transport sector that the fibrous material appears to advantage since it unites the desired sound-

absorbing properties with the low weight per unit area. As regards stationary applications, the weight per unit area is not as decisive as when it comes to mobile applications.

When the fibrous material is used as a layer in bonnet insulation, the layer of the fibrous material 1 is put together with a layer 4 of cotton rags or the like. Since the fibrous material 1 can be formed in such a manner that it is oil repellent and flame retardant, the layer of the fibrous material 1 is suitably placed so that it is turned towards the engine and the cotton rags are located closer to the bonnet. Moreover, the low air permeability of the fibrous material 1 is used for reflecting a large number of sound waves back into the engine compartment. The cotton rags 4 thus do only need to damp the sound waves which propagate through the fibrous material 1. The layer of the fibrous material 1 is brought together with the cotton rags 4 in such a manner that the tissue layer 2 is nearest to the cotton rags 4, i.e. so that the fibrous web faces the bonnet. Due to its low air permeability, the reflecting layer of fibrous material will thus prevent the propagation of sound waves (noise) from the engine compartment to the passenger compartment.

Another suitable field of application as regards the fibrous material 1 is floor carpets in cars. In this application, the fibrous material is located under the polyester carpet. The fibrous material reflects a great deal of the road noise and the carpet damps a great deal of the sound which after all propagates through the fibrous material. The fibrous material 1 is brought together with the other layers in the carpet so that the tissue layer 2 is nearest to the polyester carpet, i.e. facing the passenger compartment. Thus, in the same manner as above in connection with the application of the bonnet, sound waves (noise) from the road will be pre-

vented from propagating further to the passenger compartment.

According to a preferred embodiment, the fibrous material has a weight per unit area of about 63 g/m^2, a thickness of about 0.6 mm and air permeability of about 100 l/(m^2*s). According to another embodiment, the fibrous material has a weight per unit area of about 60 g/m^2, a thickness of about 0.9 mm and air permeability of about 1200 l/(m^2*s). Apparently, it is possible to vary the air permeability with maintained weight per unit area. The choice of portion of binder and the choice of tissue material are parameters which affect these properties. To all appearances, the thickness can be easily varied between, for example 0.6 and 0.9 mm, and the air permeability between 100 and 1200 l/(m^2*s) with maintained low weight per unit area.

Conventional non-woven and tissue material have air permeability in the range of 3000-5000 l/(m^2*s) and in the range of 2000 l/(m^2*s), respectively.

It will be understood that a large number of modifications of the described embodiments of the invention are possible within the scope of the invention, which will be defined in the appended claims.

For example, the fibrous web 3' can be put together with the tissue layer 2 after the step of impregnating D (see the dashed line in Fig. 3). In addition, the layer of tissue material can be placed above the fibrous web instead.

The different fibres and the latex can be replaced by other materials which have similar properties. In some applications, it may be possible to ignore a certain property, thus making it possible to use another type of fibre or another latex.

CLAIMS

1. A fibrous material for sound insulation in, for example, vehicles, c h a r a c t e r i s e d in that it comprises

a first layer (2) of a continuous fibrous material which has a portion of at least 50 % of short fibres having a length below about 10 mm,

a second layer (3) of free fibres or a fibrous web with a portion of at least 50 % of long fibres having a length above about 20 mm, and

a binder in the form of a polymer which is added as latex and bonding the fibres in the two layers (2, 3) and which has thermoplastic properties after manufacturing the fibrous material.

2. A fibrous material as claimed in claim 1, which has a thickness below about 2 mm.

3. A fibrous material as claimed in claim 1 or 2, in which the polymer added as latex constitutes at least 15 %, preferably at least 20 % by dry weight of the fibrous material.

4. A fibrous material as claimed in any one of the preceding claims, in which the continuous fibrous material in the first layer (2) is creped.

5. A fibrous material as claimed in claim 4, in which the first layer (2) has a degree of creping above 10 %, preferably between 20 and 30 %.

6. A fibrous material as claimed in any one of the preceding claims, in which the first layer (2) has a portion of at least 50 %, and preferably 75 %, of cellulose fibres.

7. A fibrous material as claimed in any one of the preceding claims, in which the first layer (2) has a portion of at least 75 % of short fibres having a length below about 10 mm.

8. A fibrous material as claimed in any one of the preceding claims, in which the first layer (2) has a portion of at least 50 % of short fibres having a length below about 5 mm.

9. A fibrous material as claimed in any one of the preceding claims, in which the first layer (2) has a portion of at least 75 % of short fibres having a length below about 5 mm.

10. A fibrous material as claimed in any one of the preceding claims, in which the second layer (3) has a portion of at least 75 % of long fibres having a length above about 20 mm.

11. A fibrous material as claimed in any one of the preceding claims, in which the second layer (3) has a portion of at least 50 % of long fibres having a length above about 30 mm.

12. A fibrous material as claimed in any one of the preceding claims, in which the second layer (3) has a portion of at least 75 % of long fibres having a length above about 30 mm.

13. A fibrous material as claimed in any one of the preceding claims, in which the second layer (3) has a portion of at least 50 %, and preferably 75 %, of polyester and viscose fibres.

14. A method for manufacturing a fibrous material for sound insulation in, for example, vehicles, c h a r a c t e r i s e d in that it comprises the steps of

manufacturing a continuous fibrous material, which has a portion of at least 50 % of short fibres having a length below about 10 mm,

bringing the continuous fibrous material and fibres in the form of free fibres or a fibrous web together with a portion of at least 50 % of long fibres having a length above about 20 mm,

impregnating the continuous fibrous material and the added fibres with latex, and

drying the combined and impregnated fibrous material.

15. A method as claimed in claim 14, in which the drying takes place at a temperature which is lower than the curing temperature or degradation temperature of the polymer added as latex.

16. A method as claimed in claim 14 or 15, in which the step of manufacturing a continuous fibrous material comprises the step of creping the fibrous material.

17. A method as claimed in any one of claims 14-16, in which the free fibres or the fibrous web are/is placed above the continuous fibrous material during the step of bringing the fibres together.

18. A method as claimed in any one of claims 14-17, in which the step of bringing the fibres together is carried out before the step of impregnating.

19. A method as claimed in any one of claims 14-18, which further comprises a step of removing an excess of impregnation, which is carried out after the step of impregnating and before the step of drying.

20. A method as claimed in any one of claims 14-19, in which the step of removing an excess of impregnation comprises the step of removing by suction an excess of impregnation from the fibrous material which is brought together.

21. Use of a fibrous material as claimed in any one of claims 1-13 in a sound-insulating material.

22. A sound-insulating material c h a r a c t e r i s e d in that it comprises a first layer (1) of a fibrous material as claimed in any one of claims 1-13.

23. A sound-insulating material as claimed in claim 22, which further comprises a second layer (4) of a fibrous material with a thickness above about 5 mm.

24. A sound-insulating material as claimed in claim 22, which further comprises a second layer (4) of a fibrous material with a thickness below about 5 mm.

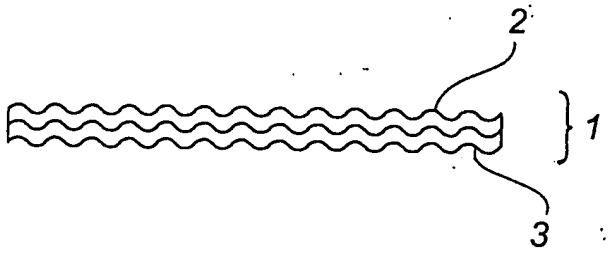

Fig. 1

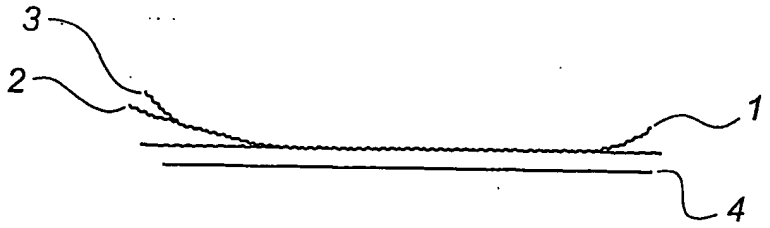

Fig. 2

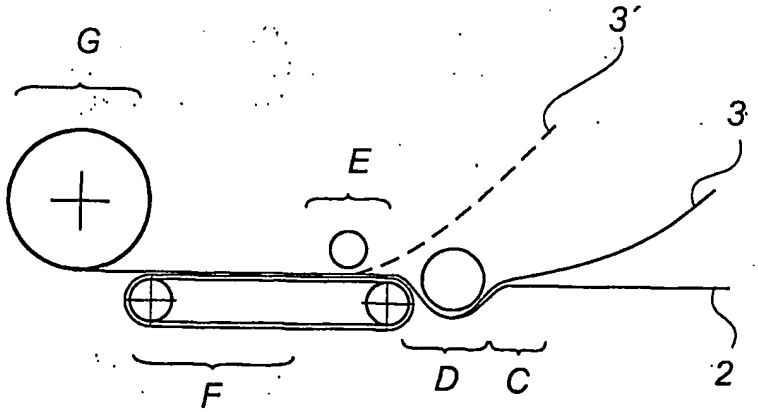

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 01/01444

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D04H 5/04, G10K 11/168
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: D04H, G10K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9313255 A1 (CENTER FOR INNOVATIVE TECHNOLOGY), 8 July 1993 (08.07.93), figures 1-6c, claims 1-19	1-3,6-13, 14-15,21, 22-24
X	GB 2111859 A (CARL FREUDENBERG), 13 July 1983 (13.07.83), figure 1, claims 1-21	1-3,6-13, 14-15,21, 22-24

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
26 October 2001	29 -10- 2001
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Agneta Änggård/EK Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
SE01/01444

Box I **Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 7-13,17-20,23-24 See next page.
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II **Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

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Multiple dependent claims shall not serve as a basis for any other multiple dependent claim. See Rule 6.4 (a).

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/10/01

International application No.
PCT/SE 01/01444

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9313255 A1	08/07/93	US 5256223 A	26/10/93
GB 2111859 A	13/07/83	DE 3145138 A,C	01/06/83
		US 4465723 A	14/08/84